

The Emergence of French Medical Entomology: The Influence of Universities, the Institut Pasteur and Military Physicians (1890–c.1938)

ANNICK OPINEL*

The term medical entomology (*entomologie médicale*) was used for the first time in France around 1910. As far as France is concerned,¹ the study of arthropods as critical components in the propagation of severe diseases such as yellow fever, trypanosomiasis, and malaria gradually emerged after 1890 in three main types of institution: civilian faculties of medicine, a specialized military medical training centre, and the Institut Pasteur. In each of these settings, medical entomology developed from different rationales and interests, and came to influence different spheres of activity. Although identified very early in France—in the last decade of the nineteenth century—as the necessary associate of parasitology and the study of tropical diseases, it was nearly twenty years before medical entomology became a defined field of knowledge within the wider discipline of entomology.

The present article surveys the respective roles of the three teaching and research institutions that played a part in the emergence of medical entomology in France. Not only were these institutions the major actors in the country at the time, but, despite their differences, they were destined in some way closely to collaborate or to create parallel international networks of research and teaching while generating a complex array of subsidiary institutions, nearly all dealing with tropical diseases.

Entomology in France at the End of the Nineteenth Century

The history of entomology in France has not yet been studied as such, but it seems that entomological knowledge developed through two main channels: private collections of insects, and the activities of the professor of entomology at the Natural History Museum in Paris.² Non-professional entomologists included private citizens—teachers, clergymen,

© Annick Opinel 2008

Annick Opinel, PhD, Centre de recherches historiques, Institut Pasteur, 28 rue du Dr Roux, 75824 Paris Cedex 15, France; e-mail: annick.opinel@pasteur.fr

I would like to thank Gabriel Gachelin, Rehseis, Université Paris 7, for his valuable and attentive help.

¹This paper deals solely with entomology in France. It takes its place alongside a more extensive and international collective work on the history of medical entomology (France, Great Britain, Italy, Brazil), *Parassitologia*, spring, 2008.

²The following publications provide the background to French entomology: Ray F Smith (ed.), *History of entomology*, Palo Alto, Annual Reviews Inc. in cooperation with the Entomological Society of America, 1973; Ian Humphrey-Smith, *The French school of parasitology. Sept siècles de parasitologie en France*, Paris, Société française de parasitologie, 1993; Jean Gouillard, *Histoire des entomologistes français, 1750–1950*, Paris, Boubée, 2004; Philippe Jaussaud and Edouard Raoul Brygoo, *Du Jardin au Muséum en 516 biographies*, Paris, Editions du Muséum national d'histoire naturelle, 2004; Yves Cambefort, *Des coléoptères, des collections et des hommes*, Paris, Editions du Muséum national d'histoire naturelle, Paris 2006.

physicians, soldiers—unaffiliated with scientific institutions but members of local associations and academies. They described the fauna of their region or that observed during travels, expeditions and sojourns abroad. They collected samples and wrote, or contributed to often highly specialized atlases and encyclopaedias which might concern just a single genus or a single group of insects.³ Reference collections in museums were based on these private collections. Nearly all the studies produced by this group were taxonomic in nature.

“Academic” entomology was gradually built up throughout the nineteenth century, with the Natural History Museum in Paris taking a leading role.⁴ Although Jean-Baptiste de Lamarck (1744–1829), professor at the Museum, introduced a rational classification of invertebrates, Pierre-André Latreille (1762–1833) should be considered the originator of the taxonomic rules for insects that were in use during the period covered by the present study. Latreille succeeded Lamarck in 1829 as professor of entomology, the first in a series of professors bearing that title. In his search for a “natural order” of insects, Latreille defined the physical characteristics of insects and re-allocated them within a classification scheme. Latreille’s taxonomic system, published in 1832 in the context of his lectures on articulate animals, was flexible enough to accommodate increasing numbers of genera and species.⁵ Latreille was succeeded by Jean-Victor Audoin (1797–1841) in 1833. Latreille and Audoin both contributed to the creation in 1832 of the *Société entomologique de France*, which brought individual entomologists and local entomological associations together around the Museum. Subsequently the *Bulletin de la Société entomologique de France*, devoted to the diffusion of entomological knowledge, was launched. After 1860, Emile Blanchard (1819–1900), professor of entomology, helminthology and ichthyology, gradually restricted access to the collections by amateurs, and the overall activity of the Museum declined, while the collections were dispersed.⁶ Eugène-Louis Bouvier (1856–1944), appointed professor of entomology in 1896, reversed this trend and re-opened the Museum’s laboratory and collections to non-professional visitors. He was assisted by the growing public interest in the biology of insects, prompted particularly by Jean-Henri Fabre’s works written for the general public.⁷ Bouvier was to play an important role in medical entomology in Africa.

Elsewhere, entomology was taught in faculties of science in the context of zoology. A discipline known as “*histoire naturelle médicale*” (medical natural history) was taught in the medical schools in the tradition of the *materia medica* of the pharmacy schools. However, entomology in the French medical schools consisted merely of the identification of biting and irritating insects and descriptions of prophylactic and curative methods,⁸

³ See Cambefort, *op. cit.*, note 2 above, for an example of the diversity and specialization of collections concerning coleoptera.

⁴ Entomology was gradually introduced in zoology courses at the University but occupied a minor place at least until Jean-Henri Fabre’s works on the biology of social insects became widely known after 1890.

⁵ Pierre-André Latreille, *Cours d’entomologie, ou de l’Histoire naturelle des crustacés, des*

arachnides, des myriapodes et des insectes, Paris, Roret, 1831.

⁶ Cambefort, *op. cit.* note 2 above, p. 126.

⁷ Jean-Henri Fabre, *Souvenirs entomologiques. Etudes sur l’instinct et les moeurs des insectes*, Paris, C Delagrave, 1879–1907; see also Cambefort, *op. cit.* note 2 above, p. 44.

⁸ D Cauvet, *Nouveaux éléments d’histoire naturelle médicale*, 3rd ed., Paris, Baillière et fils, 1885.

a situation which persisted until the beginning of the twentieth century, except in the medical faculty of Paris.

Work carried out at the Museum and the Société entomologique de France yielded a large taxonomic corpus in which most insects of medical interest were described. The first treatise on the *Diptera*, the “*mouches à deux ailes*”, was written by Johann Wilhelm Meigen (1764–1845) and extended by Justin Macquart (1778–1855).⁹ Macquart published several volumes on *Diptera* between 1830 and 1848, including a description of exotic flies.¹⁰ Meigen and Macquart’s collections provided the basis of the Museum’s *Diptera* collection. Jean-Baptiste Robineau-Desvoidy (1799–1857), who attended Lamarck’s classes from 1818 to 1821, was the dominant figure in French dipterology. He published accounts of exotic *Diptera* in 1830 and his *Histoire naturelle des diptères des environs de Paris* in 1853.¹¹ Jacques Marie François Bigot (1818–1893) continued and extended those earlier studies particularly by establishing the morphological characteristics used for defining groups of *Diptera*,¹² as did the catalogues of the French *Diptera* published in 1887 by Emile Gobert, and in 1890 by Eugène Séguy.¹³ All genera and species of importance for parasitologists were known by 1890: *Anopheles maculipennis* had been described by Meigen along with the genus *Aedes*; *Glossina longipalpis* had been described by C R W Wiedemann in 1830.¹⁴ Confusion of genera often occurred: for example, the subgenus *Stegomyia*, the vector of yellow fever, was separated from the genus *Culex* by Frederick Theobald only in 1901, *Culex pipiens* having been identified by Linnaeus in 1758.¹⁵

It is therefore evident that, at the emergence of parasitology, identification of the most important insect genera was possible, although the extent of the diversity of species within a given genus, particularly among tropical insects, was not understood, and there was also a lack of descriptions of the biology of insects. However, the extent to which this knowledge was available to parasitologists and physicians working in tropical medicine is open to question. On the whole, precise information on the taxonomy of a group or a genus of insects, the ability to identify species and sub-species, appears to have been restricted to small a group of specialists. Moreover, data accumulated at the Museum did not meet the specific requirements of research in the field. Apart from those scientists who had been trained at the Museum or had close contact with it—and were therefore most prominent in the development of medical entomology in France—the absence of local reference

⁹ J W Meigen, *Nouvelle classification des mouches à deux ailes, (Diptera L.) d’après un plan tout nouveau*, Paris, J J Fuchs, 1800.

¹⁰ Justin Macquart, *Diptères exotiques nouveaux ou peu connus*, Paris, Roret, 1838–48; *idem*, *Histoire naturelle des insectes*, Paris, Roret, 1834–35.

¹¹ J B Robineau-Desvoidy, *Essais sur les myodaires*, Paris, 1830, and *idem*, *Diptères des environs de Paris*, Auxerre, Perriquet, 1853.

¹² J M F Bigot, ‘Essai d’une classification générale et synoptique de l’ordre des insectes Diptères [VII mémoire]’, *Annales de la Société entomologique de France*, 1859, 7 (3): 201–31. A member of the Société entomologique de France, Bigot published numerous articles, mostly in the *Annales* and *Bulletin* of that society, describing *Diptera* of worldwide origin. His reference collection was purchased in 1893 by an

English dipterologist, M G H Verrall. No reference collection of exotic *Diptera* thus existed at the Natural History Museum. *Bulletin de la Société entomologique de France*, séances du 26 avril 1893, page CLXXXVII et séance du 14 juin 1893, page CXCIX; ‘Diptères CXCIX et CLXXXVII’, *Annales de la Société d’Entomologie de France*, 1893.

¹³ E Gobert, *Catalogue des diptères de France*, Caen, Delesques, 1887; E Séguy, *Atlas des diptères de France, Belgique, Suisse . . . aquarelles et dessins par E. Séguy*, Paris, Boubée, 1951.

¹⁴ C Laveissière and A Challier, *Côte d’Ivoire, carte de la répartition des glossines*, Paris, ORSTROM, 1980.

¹⁵ See Clement Ramsdale and Keith Snow, ‘A preliminary checklist of European mosquitoes’, <http://www.uel.ac.uk/mosquito/issue5/checklist.htm>.

collections of insects and books for identification most probably slowed down work in areas of tropical research.¹⁶ Such a situation was not specific to France, and was experienced at the turn of the century by British physicians such as Ronald Ross,¹⁷ and the Brazilian Adolfo Lutz and his co-workers.¹⁸

Entomology at the Faculty of Medicine in Paris

Raphaël Blanchard (1857–1919), professor at the faculty of medicine in Paris, was the first to express concern about the poor teaching of medical students regarding the role of animals, particularly arthropods, in the propagation of human diseases. The materia medica taught in medical schools was no longer adapted to medicine, although, as Blanchard noted, “the parasitic role of lower animals and plants was becoming more and more evident and attracted keen attention.”¹⁹

A scientist trained in both zoology and physiology, and a physician, Blanchard changed the title of the chair of natural history at the faculty of medicine to “natural and medical history (*chaire d’histoire naturelle et médicale*) in 1897.²⁰ The break with the “older” natural sciences became evident at that moment. It was preceded in 1890 by the publication of Blanchard’s *Traité de zoologie médicale*,²¹ and followed by the suppression of the faculty’s botanical garden. Other French medical faculties, where botany-dominated natural sciences were still taught, showed no inclination to follow suit. As assistants in his work, Blanchard recruited zoology-minded physicians such as Jules Guiart (1870–1965), Maurice Neveu-Lemaire (1872–1951), and later Emile Brumpt (1877–1951). They had all been influenced by research on invertebrates and particularly by Henri de Lacaze-Duthiers’s (1821–1901) experimental approach to teaching. Lacaze-Duthiers, founder of the marine laboratories of the University of Paris (at Roscoff and Banyuls), was a

¹⁶ Even in 1910, despite numerous publications readily available, specimens were most often sent to the Museum for proper identification.

¹⁷ In his Nobel lecture in 1902, Ronald Ross said that, until 1898, he was unable to obtain sufficiently precise documentation for the identification of mosquitoes: “Before leaving England I had made many attempts to obtain literature on mosquitoes, especially the Indian ones, but without success except for some brief notes in encyclopedias.” Ronald Ross, ‘Researches on malaria’, Nobel lecture, 12 Dec. 1902, from *Nobel lectures, physiology or medicine 1901–1921*, Amsterdam, Elsevier, 1967, p. 38, available on <http://nobelprize.org>. He thus provided his own descriptions: “Brindled mosquitoes”, later identified as belonging to the genus *Stegomyia*; “grey mosquitoes”, now *Culex*; and “spotted wings mosquitoes”—*Anopheles*. The genera had already been described, but the correct identification of a given specimen was a difficult task.

¹⁸ Jaime L. Benchimol, Magali Romero Sá, *Adolpho Lutz, Obra completa*, 4 vols, Rio de Janeiro, Fiocruz, 2006, vol. 2.

¹⁹ “En revanche, le rôle parasitaire des animaux et des végétaux inférieurs devenait de plus en plus

manifeste et sollicitait très vivement l’attention”, Raphaël Blanchard, ‘La chaire d’histoire naturelle médicale de la Faculté de médecine de Paris; son histoire’, *Archives de Parasitologie*, 1907, **11** (3): 481–92, on p. 485.

²⁰ Raphaël Blanchard founded the Société zoologique de France (1876). He worked in Charles Robin’s laboratory on the histology of various animals between 1876 and 1878, and spent a year (1877–78) in Austria and Germany studying embryology and comparative anatomy. His MD dissertation was related to work he had carried out in Paul Bert’s laboratory on the anaesthetic properties of nitrogen monoxide (1880). From 1883 he taught medical zoology at the faculty of medicine in Paris. He does not appear to have practised medicine or parasitology, but as having worked, on the scientific side, on invertebrates like leeches, and, at the institutional level, where he made important changes in the organization of medical teaching and zoological taxonomy.

²¹ R. Blanchard, *Traité de zoologie médicale*, 2 vols, Paris, J B Baillière, 1889–1890.

The Emergence of French Medical Entomology



Figure 1: Raphaël Blanchard (1857–1919). (Courtesy the Photothèque historique, Institut Pasteur, Paris.)

renowned specialist in marine invertebrates and professor of invertebrate zoology at the Natural History Museum from 1864 until his death. Blanchard oriented medical zoology towards parasitology exclusively, and in 1906, effected another change of the name of his professorship to that of “parasitology and medical natural history” (*chaire de parasitologie et d’histoire naturelle médicale*). A similar teaching model already existed in England. Blanchard took the London School of Tropical Medicine and the Liverpool School of Tropical Diseases as models and supported Patrick Manson’s idea of dividing the teaching of parasitology into two distinct areas: helminthology and protozoology.

In France, at the beginning of the twentieth century, courses on exotic diseases were primarily given in the naval medical institutions of Bordeaux (in association with the newly created local faculty of medicine and pharmacy) and in Paris at the Ecole du Val-de-Grâce, in obvious response to the needs of military physicians in the colonies. Courses on exotic diseases and parasitology were not generally provided in civilian medical schools. In part to remedy this, in 1902, Blanchard created the Institut de médecine coloniale, also inspired by the London and Liverpool models.²²

²²See R Blanchard, ‘L’Institut de médecine coloniale, histoire de sa fondation’, *Archives de Parasitologie*, 1902, 6 (4): 585–603. The Institut de médecine coloniale was founded in 1902 after three years of negotiation between the faculty of medicine in Paris and the Union coloniale. Initially intended to be set up in the Maison de convalescence des militaires coloniaux (Croix verte) at Sèvres (close to Paris) where Blanchard would organize a small laboratory with Guiart and Neveu-Lemaire, the project was then halted for complex reasons. As a temporary measure, the faculty of medicine initially provided space for

courses and laboratories. The problem of clinical teaching was acute because Blanchard could not find a hospital for patients with tropical diseases. Under a local regulation, the public Parisian hospitals were not allowed to treat patients suffering from tropical diseases. The result of this was that, at least in Paris, civilians returning from the colonies could be treated only in private hospitals. The Institut Pasteur hospital, newly built, was proposed. But, in spite of Roux’s (the Institut Pasteur’s director) favourable attitude, this was impossible, because the hospital had been built specifically to treat contagious diseases, and it could

All teaching and training at Blanchard's institute were conducted by civilian teachers. The number of students was quite constant from 1902 to 1911—around thirty a year. Half were French, and the rest were mainly from Latin America, with a majority being physicians over the age of thirty. The diploma granted was that of *Médecin colonial de l'Université de Paris*, which allowed the recipient to use the title *Médecin sanitaire maritime*. Nearly all the physicians who graduated were civilians, and remained in the civil field. Some obtained positions in shipping companies, others in the colonies' mines, colonial businesses or in the administration of agricultural enterprises. In Tonkin and French West Africa these graduates also provided medical assistance to the indigenous populations. Despite the importance of the military medical services in the French colonies, there is no evident connection between the Institut de médecine coloniale and the military during the first decade of the twentieth century.²³

The courses given at the Institut de médecine coloniale show that its purpose was to train physicians specifically in tropical medicine. The schedule of studies also indicates the place accorded to parasitology and entomology. In 1902, theoretical studies, clinical studies and laboratory work were organized as follows: André Chantemesse (an Institut Pasteur microbiologist) taught bacteriological and haematological techniques (15 lessons and 15 practical demonstrations); Raphaël Blanchard, parasitology (21 lessons and 21 practical demonstrations); Auguste Le Dentu, tropical surgery (4 lessons); Félix de Lapersonne, tropical ophthalmology (4 lessons); R Würtz, exotic pathology (17 lessons), bacteriological diagnosis applied to tropical diseases (20 practical exercises); and E Jeanselme, dermatology (10 lessons).²⁴ Animal parasites were dealt with in 16 lessons on sporozoa, hæmatozoa, zoological and taxonomic survey of mosquitoes, flagellates, cestods, trematods, nematods, strongyloids, filaria, acanthocephala, arthropods, acarians, parasitic diseases, with the remaining three devoted to fungi and poisonous animals. It is worth noting that within this very specialized teaching programme, not only had the word entomology, and *a fortiori* the expression “medical entomology”, still not occurred, but that not much time was given to insect vectors.

It was not until 1910 that the word “entomology” was at last used in a medical context when Blanchard delivered a general lecture on the history of medical entomology at the First Congress of Entomology in Brussels.²⁵ A year later, in Blanchard's draft report, the teaching programme in parasitology at the Institut de médecine coloniale remained the same as in 1902, but more importance was given to vectors.²⁶ In accordance with his admiration for the London and Liverpool schools and their teaching of medical entomology (as well as their scientific missions abroad, especially their permanent stations in

not be used for other purposes. This may be an disingenuous explanation since several anti-parasite drugs were soon tested at the Institut Pasteur hospital on patients with malaria and sleeping sickness. Blanchard finally found a private hospital in Auteuil, the Hôpital des Dames Françaises, to accommodate patients and for proper clinical teaching.

²³No details are available after 1920. Moreover, Emile Brumpt, who was in charge of the Institut de médecine coloniale after 1919, never worked with military institutions. The Institut was still running in

1938, and Lucien Brumpt (1910–99), Emile Brumpt's son, himself a parasitologist, had just been named *chef de travaux pratiques*.

²⁴Blanchard, op. cit., note 22 above.

²⁵R Blanchard, 'L'Entomologie et la médecine', in *Congrès international d'Entomologie, Bruxelles, 1910*, Brussels, Hayez, 1912, pp. 114–23.

²⁶Archives IP, BLR 4, boîte Blanchard 4, Raphaël Blanchard, 'Coup d'œil sur l'Institut de médecine coloniale', *Archives de parasitologie*, 1911, **14**: 452–71.

Kuala Lumpur for London and Manaus for Liverpool), Blanchard joined the antivectorial fight and emphasized the major connection between exotic pathology and entomology as a recently established notion. “Without a precise knowledge of the conditions in which such animals intervene in the aetiology of tropical diseases, there is no rational prophylaxis.”²⁷ Among the first in France to have clearly understood the growing role of zoology in medicine, Blanchard thus set up the basis for the definition of medical entomology, albeit a contingent formulation, as a distinctive field of research and medical training. In the meantime, he organized the corresponding teaching institutions.

He was greatly helped in this endeavour by his team of co-workers. One of the most important of these was Emile Brumpt, who taught parasitology and entomology at the faculty of medicine, first under Blanchard, and, after 1919, as his successor. Brumpt’s biography has been largely presented elsewhere.²⁸ Trained first as a zoologist, he was very aware of the importance of invertebrate zoology. His doctoral thesis on leeches (a family of animals well studied by Blanchard) led to his MD in 1906. Brumpt joined Blanchard’s laboratory in 1899 as his assistant; in 1906, he became head of practical research in parasitology at the faculty of medicine, and in 1907 was appointed professor of parasitology and medical natural history.²⁹ Such a career evidently followed the logic of Blanchard’s dictates. What made Brumpt’s contribution to parasitology and entomology original was the manner in which he combined results and observations made during his travels and expeditions with laboratory work and clinical descriptions. The work carried out during his participation in the Du Bourg de Bozas expedition from Djibouti to Brazzaville (1901–3), sponsored in part by the Institut de médecine coloniale and the Société de géographie,³⁰ was an example of his methods. His early field studies on the presence of various *Glossina* species and the occurrence of animal and human trypanosomiasis constitute a neatly defined corpus of research on the links between environment, insect, parasite and disease, an approach he followed throughout his career.³¹ Brumpt’s analyses are remarkable in that they closely associate the study of parasite and vector as observed in the field and the laboratory, i.e. parasitology, entomology and parasitic diseases. As a doctor, Brumpt was deeply concerned with the anti-vectorial campaign,

²⁷ Blanchard, see note 27 above, p. 458. “Sans la connaissance précise des conditions suivant lesquelles de tels animaux interviennent dans l’étiologie des maladies tropicales, il n’y a point de prophylaxie rationnelle.”

²⁸ As well as being a teacher, Brumpt was an important researcher in parasitology, who had an especially wide entomological and biological knowledge of vectors. He was also active as a physician. See Annick Opinel and Gabriel Gachelin, ‘Emile Brumpt’s contribution to the characterization of parasitic diseases in Brazil (1909–1914)’, in A Opinel and G Gachelin (eds), *Parasitic diseases in Brazil: the construction of parasitology, XIX–XXth centuries*, special issue of *Parassitologia*, 2005, 47: 299–307. For the funding of his numerous missions around the world (most of them not supported by the faculty of medicine in Paris), see Emile Brumpt, *Titres*

et travaux scientifiques (Paris, Masson, 1934), and, as an example, A Opinel and G Gachelin, ‘The Rockefeller Foundation and the prevention of malaria in Corsica 1923–1951: the support to the French parasitologist Emile Brumpt’, *Parassitologia*, 2004, 46: 287–302.

²⁹ After returning from Africa, Brumpt became *chef des travaux pratiques de parasitologie* at the Institut de médecine coloniale in 1903, a minor position, and was appointed *secrétaire général* in 1919 after Blanchard’s death.

³⁰ Brumpt participated as naturalist and physician in the expedition organized by Viscount Robert du Bourg de Bozas, which crossed equatorial Africa from the Red Sea to the Atlantic. See E Brumpt, *Mission du Bourg de Bozas. De la Mer Rouge à l’Atlantique, à travers l’Afrique tropicale*, Paris, Rudeval, 1903.

³¹ Brumpt, op. cit., note 28 above.



Figure 2: Emile Brumpt (1877–1951). (Courtesy the Photothèque historique, Institut Pasteur, Paris.)

especially against malaria, as can be seen from his work in Corsica in 1925–26,³² and he proposed an environmental approach to eliminating *Glossina* in the Congo as early as 1903.³³ He liked to remind people that he had been trained as a zoologist.

The place that Brumpt accorded to entomology can be appreciated through his teachings and books. In 1922 he taught at the Paris faculty of medicine laboratory of parasitology at 15, rue de l'École-de-médecine, of which he was now the head.³⁴ The teaching programme (*cours de perfectionnement*) was shared among Professeur Charles Joyeux, Maurice Neveu-Lemaire, *chef de travaux*,³⁵ Maurice Langeron, *chef de laboratoire*,³⁶ and three assistants, including Fernand Larrousse, in charge of agricultural and medical entomology. Brumpt's laboratory had collections of macroscopic and microscopic preparations, and living fungi, as well as large collections of insects associated with parasitic diseases.³⁷

³² See A Opinel and G Gachelin, 'Le parasitologue, l'anophèle et les gambusia : le paludisme en Corse (1925–1930)', in P Bourdelais and O Faure (eds), *Les nouvelles pratiques de santé*, Paris, Belin, 2005, pp. 195–210.

³³ E Brumpt, 'Maladie du sommeil et mouche tsé-tsé', *C. R. Soc. Biol.*, 27 juin 1903, **55**: 839.

³⁴ E Brumpt (ed.), *Enseignement complémentaire de la parasitologie appliquée au diagnostic, à l'hygiène et à l'épidémiologie. Faculté de médecine de Paris, laboratoire de parasitologie*, Paris, Masson, 1922.

³⁵ Maurice Neveu-Lemaire (1872–1951), Brumpt's *chef de travaux* from 1920 to 1935, was a physician, *agrégé d'histoire naturelle*, and a graduate

of Liverpool School of Tropical Diseases and Medical Parasitology. He taught at both the Institut de médecine coloniale in Paris and, in 1926, at the Ecole de malarologie at the University of Paris. He wrote a *Traité d'helminthologie médicale et vétérinaire* in 1936 and a *Traité d'entomologie médicale et vétérinaire* in 1938.

³⁶ Maurice Langeron (1874–1950), physician and mycologist, joined Blanchard's laboratory in 1903 and started working with Brumpt in 1906. He was the founder, along with Brumpt and Neveu-Lemaire, of the *Annales de parasitologie humaine et comparée* in 1923.

³⁷ Described in Brumpt (ed.), op. cit., note 34 above, p. 4.

The Emergence of French Medical Entomology

The library was well stocked and international (after books in French, the most numerous were those in English).

Brumpt's *cours de perfectionnement* consisted of six sessions of ten lectures each: techniques, protozoology, helminthology, medical entomology, mycology, and holiday lectures (all ten of which were devoted to host vectors³⁸).

The prominence that Brumpt gave to medical entomology is thus apparent. This is confirmed by the books he used for teaching, which develop the original *Traité de zoologie médicale* written by Blanchard: the 1216-page third edition (1922) of Brumpt's *Traité de parasitologie* contains 250 pages on arthropods—nearly one-fifth of the total. Blanchard had separated medical entomology from medical zoology. Brumpt placed it as a well-identified, integral component of parasitology and other arthropod-borne infectious diseases.

It is interesting to note the international aspect of Brumpt's personal role in research and in the teaching of every aspect of parasitology and medical entomology. Brumpt's personality was such that he had many important contacts abroad, especially in South America (he founded the chair of parasitology in the São Paulo faculty of medicine in 1913 and contributed a great deal to the understanding of the biology of *Trypanosoma cruzi* and of Chagas' disease³⁹). After the First World War, he travelled very widely except, notably, in Africa, possibly because that continent was under the Institut Pasteur's influence.⁴⁰ His activities became institutionalized at the international level. In 1926, he was made director of the Ecole de malarologie of the University of Paris, founded the same year at the instigation of the Health Committee of the League of Nations of which he was a member. He was strongly supported by the Rockefeller Foundation,⁴¹ and the Health Committee backed his epidemiological studies in the Middle and Far East before the Second World War. His research and teaching methods spread widely outside France, and in turn he brought back scientific information in the form of samples, epidemiological records and photographs. Brumpt, the leading medical figure in parasitology and medical entomology in France at least until the Second World War, propagated the concept, created by Blanchard, of medical entomology as a component of a more complex scientific structure associating insect, parasite, environment and disease.

Medical Entomology at the Institut Pasteur

The Institut Pasteur was created in 1887, at the moment when Blanchard was redirecting the teaching of natural medical sciences at the faculty of medicine towards medical zoology. The senior scientists then working at the Institut Pasteur were all microbiologists: Louis Pasteur, Elie Metchnikoff (*microbie morphologique*), Emile Roux, Edmond Nocard and Albert Calmette (*microbie technique* and courses), Charles Chamberland (*microbie appliquée à l'hygiène*) and Emile Duclaux (*microbie générale*). Apart from Metchnikoff, not one of them was a zoologist, nor had any of them (including Metchnikoff) trained as a

³⁸The notion of "hôtes vecteurs" appears in Brumpt (ed.), *Enseignement complémentaire* (op. cit., note 34 above). It is not mentioned in the 1913, 1922 and 1927 editions of his *Traité de parasitologie* but does appear in the 1936 and 1949 editions (see the definition in

Traité de parasitologie, Paris, Masson, 1936, p. 24).

³⁹Brumpt, op. cit., note 28 above, p. 32.

⁴⁰Ibid., pp. 33–8.

⁴¹Opinel and Gachelin, 'The Rockefeller Foundation', op. cit., note 28 above.

protistologist or an entomologist, and they all worked on the agents of conventional infectious diseases.

Among the staff of the institute, Metchnikoff (1845–1916), who was not a physician, expressed an early interest in protozoology, particularly concerning the malaria agent.⁴² His interest in so-called “natural immunity”, along with his earlier work at the marine laboratory of Naples and at several zoology-oriented laboratories in Austria and Germany, may explain why he offered laboratory space to Alphonse Laveran in 1896, immediately after the latter had resigned from the army because it was not prepared to provide him with laboratories and access to patients. Metchnikoff also supervised Paul-Louis Simond’s initial work on *Plasmodium*. The presence of Laveran and Simond in Metchnikoff’s laboratory could be taken as the first sign that protozoology was becoming part of the scientific interests of the Institut Pasteur.

The chronology of the creation of laboratories at the Institut Pasteur indicates the progressive involvement of the institution in insect-borne tropical diseases. In 1899, Felix Mesnil (1868–1938) joined Laveran at his request, and set up, still within Metchnikoff’s laboratory, a laboratory of protozoology and tropical zoology, thus reinforcing the circle of scientists around Metchnikoff working on protozoology. Mesnil was not a physician either; he trained as a zoologist at the Ecole normale supérieure and specialized in protists, particularly under the influence of Alfred Giard,⁴³ and during 1891 to 1892 worked in zoology laboratories in Germany as well as for Metchnikoff. Mesnil’s laboratory became independent in 1907 and remained so until his death in 1938. The work carried out there at the beginning of the twentieth century predominantly concerned *Trypanosoma*—research initiated along with Laveran⁴⁴—and other parasites such as *Leishmania*. However, Mesnil did little entomological work proper. With the funds from his Nobel Prize, in 1907, Laveran created within the Institut Pasteur the Tropical Disease Section, of which he remained the head until his death in 1922. The work carried out in this laboratory was predominantly on *Leishmania* and *Plasmodium*, and, again, included little entomology.

Also in 1907 a laboratory of tropical microbiology (*Service de microbiologie tropicale*) was established, with Emile Marchoux (1862–1943) as its head. A former naval physician, Marchoux had previously worked on yellow fever and prevention procedures in Senegal and Brazil. After resigning from the navy, he immediately joined the Institut Pasteur in 1905 and worked on malaria and leprosy. Marchoux must have become aware of the taxonomy and biology of *Stegomyia* when working on yellow fever.⁴⁵ However, he was not a trained entomologist, and, although his description of the biology of *Stegomyia* offers perspectives for prophylaxis, he did not carry on his work in entomology.

⁴² Archives de l’Institut Pasteur (hereafter AIP), fonds Mesnil, Box MES 02. In an unidentified journal, Félix Mesnil celebrates the fiftieth anniversary of the discovery of *Plasmodium* by Alphonse Laveran and acknowledges Metchnikoff’s interest in the topic. He says that Metchnikoff had engaged Paul-Louis Simond to work on coccidias.

⁴³ Alfred Giard (1846–1908) was trained as a zoologist by Henri de Lacaze-Duthiers. He taught zoology at the University of Lille and at the Ecole normale supérieure in Paris, and set up his own marine

biology laboratory at Wimereux in 1874. He was president of the Société entomologique de France from 1896 until his death. He was a follower of Lamarckism.

⁴⁴ They published a reference book together, two editions of which were published: F Mesnil and A Laveran, *Trypanosomes et trypanosomiases*, Paris, Masson, 1904 and 1912.

⁴⁵ Ilana Löwy, *Virus, moustiques et modernité: la fièvre jaune au Brésil entre science et politique*, Paris, Editions des archives contemporaines, 2001.



Figure 3: Félix Mesnil (1868–1938). (Courtesy the Photothèque historique, Institut Pasteur, Paris.)

Although involved in the biology of parasites, the Institut Pasteur did little work on the entomological side until a laboratory of medical entomology and parasitological biology, directed by Emile Roubaud (1882–1962), was created in 1912, at Mesnil's request.⁴⁶ Roubaud also was a zoologist and not a physician, and he specialized in entomology when working at the Museum of Natural History under the supervision of Bouvier and J Villeneuve. He worked sporadically in Mesnil's laboratory at the Institut Pasteur from 1905 until 1912, but most of his research was done in Africa on the biology of *Glossina*, before he set up his own laboratory.

The development and organization of the Institut Pasteur's microbiology course—Roux's *Cours de microbie technique* from 1888 until 1913, and Calmette's *Cours supérieur de microbiologie* after 1921—reflect the increasing interest in parasites and their vectors at that institution. The teaching of protozoology proper was introduced by Laveran in 1898, and the course was taken over by Mesnil in 1899.⁴⁷ A total of 12 lectures out of 98 dealt with parasites and their vectors, when known. The insect vectors (with the exception of *Anopheles sp.*) were succinctly but accurately described along with the parasites and the diseases they cause. *Glossina palpalis* was presented during laboratory work. Other insect-borne diseases such as tick fever and yellow fever were similarly treated in lessons that focused on the disease rather than on the vector. Entomology was not, at that time,

⁴⁶The chronology has been reconstituted by Sandra Legout, 'La famille pasteurienne. Le personnel scientifique permanent de l'Institut Pasteur de Paris entre 1889 et 1914', Paris, Mémoire de DEA, EHESS, 1999.

⁴⁷AIP, Fonds Ramon, Box RAM 41-43, Lessons 65 to 76 course 1910–1911.



Figure 4: Emile Roubaud (1882–1962). (Courtesy the Photothèque historique, Institut Pasteur, Paris.)

singled out as a topic in courses on infectious agents and the infections they cause. It was not until 1913 that a course of medical entomology, set up by Roubaud, began to be taught. The microbiology course was not given between 1914 and 1921. It resumed in 1922 when it was divided into two parts, the second of which was devoted to parasitic diseases and taught by Roubaud and Mesnil only. Detailed descriptions of each insect vector were given, along with the cycle of the agent and the pathology it is responsible for. Non-tropical insects causing infections such as *Ixodes* were also described. In 1926, this part of the course of microbiology was transformed into a course of medical protozoology, an arrangement that persisted until Mesnil's death in 1938.⁴⁸ Medical entomology was thus closely associated with the study of parasites and diseases and was a sub-field of entomology applied to medical problems.⁴⁹

⁴⁸The courses given at the Institut Pasteur are kept as bound books in the Archives de l'Institut Pasteur, with no shelf-mark. The series is complete from 1922 to the present.

⁴⁹A series of lectures, presumably dated 1948, since the most recent reference quoted is in 1947, entitled *Cours Roubaud, Laboratoire d'entomologie médicale et zoologie tropicale, Institut Pasteur* may have followed the Roubaud-Mesnil course. It showed a shift in Roubaud's thinking concerning medical entomology. The previously integrated description of parasite and disease had virtually disappeared in favour of a specialized field of insect sciences, in

which medical entomology was used as the basis for a theoretical discussion of the adaptation processes of certain insects. Roubaud started the course with a definition: "The object of medical entomology in broad terms is the study of arthropods or articulated animals which may harm human or domestic animal life, as well as clarifying rationally their pathogenic action and setting up effective means of intervention." ("L'Entomologie médicale a pour objet l'étude, au sens large, des Arthropodes ou Articulés susceptibles de nuire à la vie de l'homme ou des animaux domestiques, d'éclairer rationnellement leur action pathogène et de lui apporter des mesures

At the Institut Pasteur, therefore, the two leading figures dealing with medical entomology were Roubaud, the entomologist, and Mesnil, the parasitologist. Their fields of research appear complementary, but the two men did not actively cooperate, and jointly wrote only three papers over a period of thirty-five years. By contrast, a total of 275 papers were written by Roubaud alone or in collaboration with others. In addition, their three joint papers all dealt with minute aspects of malaria, none with sleeping sickness, on which they both worked.⁵⁰ Under Roubaud, medical entomology at the Institut Pasteur became a distinctive research field associated with a specialized laboratory.

The *Cours de microbie technique* created by Roux in 1888 was originally intended to teach new techniques concerning the identification of microbes, bacteriological diagnosis, prophylaxis, and treatment, none of which were taught at the faculties of science and medicine.⁵¹ Thus, despite the fact that the Institut Pasteur, as a private institution, could not award official state diplomas, the diploma of *élève du cours* was highly regarded and considered the hallmark of expertise in microbiology. The *grand cours* accepted both French and foreign physicians, veterinarians and pharmacists, civilians and military, in fact anyone wishing to complete this training. The *cours* thus contributed to expanding the group of people influential in all fields of medicine and public health who were linked together by their “debt” to the Institut Pasteur. In particular, the contribution of military physicians so trained proved critical in the development of the Institut Pasteur in the colonies.

Requests from the French Colonies and the Development of Medical Entomology at the Institut Pasteur

Yellow fever, malaria and sleeping sickness were endemic in the French colonies and the administered territories. Immediately after the discovery of the vectors of these diseases, several missions were organized, all of which involved the Institut Pasteur. Their aims were to study the parasites and their vectors and to define better prophylaxis and treatment. The involvement of the Institut Pasteur in the control of parasitic diseases stemmed from Roux’s own initiative⁵² or from responses to state agency requests and followed the discoveries of new parasites and new vectors. Several important missions organized

d’intervention efficaces.”) (AIP, Fonds du service d’entomologie médicale, Box SEM 1, *Cours Roubaud*, fascicule 1, cours 1, p. 1). This course was now a genuine entomology course organized around the notion, familiar to Roubaud from his thesis, of the physiology of insects resulting from their adaptation to distinctive features of an ecosystem. The titles of the lectures were examples of that attitude: ‘L’adaptation hématophage’, ‘Tropismes hématophages’, ‘Evolution chez les hexapodes hématophages’, and ‘Nutrition et ponte’ (*Cours Roubaud*, see above).

⁵⁰ Articles published jointly by Mesnil and Roubaud: ‘Sur la sensibilité du chimpanzé au paludisme humain’, *C. R. Acad. Sci.*, 1917, **165**: 39;

‘Insectes et infections. Les conditions de l’infection aux armées’, *C. R. Soc. Biol.*, 16 Nov. 1918, **81**: 1029; ‘Essais d’inoculation du paludisme au chimpanzé’, *Ann. Inst. Pasteur*, 1920, **34**: 466–79; see also Emile Roubaud, *Titres et travaux scientifiques*, Laval, Barnéoud, 1935.

⁵¹ Claude Lapresle, ‘Le rôle de l’hôpital de l’Institut Pasteur dans l’application à la médecine de découvertes fondamentales’, in Michel Morange (ed.), *L’institut Pasteur: contributions à son histoire*, Paris, La Découverte, 1991, pp. 45–51.

⁵² Roux, founder of the *Cours de microbie technique*, was at that time *sous-directeur* (1896–1904) then *directeur* of the Institut Pasteur (1904–1933).

between 1901 and 1914 were placed under the scientific authority of the Institut. Their surveys helped to establish a network of persons and interests linking the army, the navy in particular, the Institut Pasteur, and the growing list of satellite Pasteur institutes in the colonies.⁵³

The brothers Edmond and Etienne Sergent's expedition to Algeria in 1900 was the first to verify Ross's hypothesis regarding the transmission of malaria by the *Anopheles* mosquito and to develop proper control of the disease. The mission was Roux's answer to a request from the central government in Algeria.⁵⁴ It produced long-term studies on the behaviour and biological cycle of the *Anopheles* mosquito in association with studies on its local ecosystem. These resulted in the development by the Institut Pasteur of Algiers of a combined strategy of drainage and chemical control for malaria; this was applied both in the field in the country itself, and in the fight against malaria in the Balkans during the First World War.

The aim of the 1901 to 1903 expedition to Brazil by Emile Marchoux, Paul-Louis Simond (1858–1947) and Alexandre Salimbeni (1867–1942) was to verify Walter Reed's hypothesis that yellow fever was transmitted by *Stegomyia*. It resulted in the definition of a practical protocol for preventing transmission by insects, used later by Simond in the West Indies. Originally the work of the mission was purely technical, but it involved an interesting entomological aspect concerning the infestation of *Stegomyia* eggs by the virus. The participants were clearly not trained entomologists. This well-studied expedition⁵⁵ was launched at the initiative of the health department of the governorate of Senegal, thus under the Ministry of Colonies, and was placed under Roux's scientific supervision.⁵⁶ Less well known is the fact that Roux was then president of the committee of military hygiene, and was in contact with the naval surgeon General Charles Grall, head

⁵³The Instituts Pasteur d'Outre-mer (IPOMs) were created from 1888, date of the establishment of the Institut Pasteur in Paris; examples are: French Indochina: Saigon, 1891; North Africa: Algiers, 1909; Sub-Saharan Africa: Brazzaville, 1908. Today, a network of twenty-two institutions remains, of which nineteen bear the name of Pasteur. The IPOMs were very close to the local governments, as they were in fact created to support French public health and prophylaxis policy in the colonies. See Jean-Pierre Dedet, *Les Instituts Pasteur d'Outre-mer. Cent vingt ans de microbiologie française dans le monde*, Paris, L'Harmattan, 2002.

⁵⁴Edmond Sergent, *Les travaux scientifiques de l'Institut Pasteur en Algérie de 1900 à 1962*, Paris, PUF, 1964, p. 13.

⁵⁵Löwy, op. cit., note 45 above, pp. 12–17, 68–83.

⁵⁶The military hierarchy in the colonies was quite complex. The services of public health depended on the local colonial administration: in Africa on the government of French West Africa (encompassing Senegal, Sudan, Guinea, the Ivory Coast, Dahomey (now Benin)) created on 15 June 1895; and on the government of French Equatorial Africa created in 1908 (comprising Gabon, Moyen-Congo, Oubangui-Chari, and Tchad). These governments were under the

administrative supervision of the Ministry of the Colonies, created in 1894 from a part of the Ministry of the Navy. The health service for the military was under the control of both the Ministry of the Colonies (Direction des services militaires, third section) and the Ministry of War. Public health and the sanitary police in the colonies came under the control of another department of the Ministry of the Colonies, the Inspection générale du Service de Santé. (Henri Mariol, *La chronologie coloniale contenant les dates principales de l'histoire, de l'organisation, de la législation et de l'administration des colonies françaises des origines à nos jours*, Paris, Larose, 1921.) The colonial troops and the officers of the Corps de santé militaire came under the authority of the Ministry of War (see article 11 of the organization and composition of colonial troops). The Ministry of War worked in close collaboration with the Ministry of the Colonies (the phrase "*après entente avec le ministère des colonies*" is often used in official documents), so the health services were doubly supervised. In addition to this complex organization, the colonial troops were under the authority of the governor-generals of each colony (*Loi sur l'organisation des troupes coloniales, 7 juillet 1900*).

The Emergence of French Medical Entomology

of health services in West Africa and later in Indochina. It appears that Roux and Grall kept in close touch afterwards, and that Roux helped both Marchoux and Simond obtain promotion.⁵⁷

The research carried out during these missions was aimed predominantly at designing ways to control disease, largely using an anti-vector approach. The expeditions organized to the Congo in 1906–8 and to French West Africa in 1909–12 to investigate sleeping sickness and propose control strategies, originally had the same purpose. The participation of genuine entomologists in these missions illustrates the importance accorded to entomology and the complexity of the institutional network now involved. They also yielded significant scientific results. Those of the Congo expedition were published by the Société de géographie, which had organized it.⁵⁸ The organizing committee headed by Roux (Institut Pasteur) brought together Alexandre-Marie de Kermorgant, inspector general of the colonial health service, Laveran (Institut Pasteur), Mesnil (protozoologist, Institut Pasteur), Bouvier (entomologist, Museum of Natural History)—Roubaud's uncle, who was responsible for reviving and re-opening to non-professionals the Museum's entomology collections—and Giard (zoologist, University of Lille). At the suggestion of Kermorgant, Roux and Bouvier, Gustave Martin, an army physician, was named head of the mission, which included A Leboeuf (an army physician), Roubaud (entomologist) and A Weiss (zoologist). The medical objectives drawn up by Laveran were: the study of the distribution of *G. palpalis* and of sleeping sickness in the Congo, the formulation of an early diagnosis of trypanosomiasis, and the establishment of the diagnostic significance of cervical adenopathies. The zoological objectives written by Bouvier and Giard were to search for the natural history of *G. palpalis* and its biology, the other arthropods able to transmit the disease, the natural hosts of *Trypanosoma gambiense*, to investigate the adaptation of the vector to the climate, and to seek methods of prevention. The mission was placed under the scientific supervision of the Institut Pasteur and arrived in Brazzaville in November 1906. A laboratory was built by the *Commissaire général* Gentil along with an insectarium and a small hospital (inaugurated on 1 March 1907, with laboratories located close by). The building became the Institut Pasteur de Brazzaville in 1909. Concerning medical entomology, *La maladie du sommeil* contains a 265-page chapter entitled 'Biologie du trypanosome', written entirely by Roubaud, which gives the entomological and protozoological results. Several other results, not included in the mission's report, also combined entomology and parasitology and were published in journals or discussed in letters.⁵⁹

⁵⁷ AIP, Fonds Simond Box SIM 12, File 'Simond Marseille 1906–1911, Correspondance'. Letter dated 28 June 1908 from Charles Grall, Inspecteur général du service de santé, Ministère de la guerre, to Simond: "Mr Roux has taken most active steps on your behalf, and the people in charge will remember this when the time comes". (" M. Roux a fait en votre faveur les démarches les plus actives et les grands chefs s'en souviendront au moment propice"). Roux's support of Simond is also obvious in a letter from Grall to Simond (then in Constantinople) dated 19 Sept. 1913, indicating that Roux strongly supported Simond's nomination in Indochina. In a letter to Marchoux dated 26 Nov. 1906, Grall says that Roux is strongly in favour

of Marchoux's promotion. In the end Marchoux retired from the army and entered the Institut Pasteur in 1906 as head of the microbiological department.

⁵⁸ Gustave Martin, Alexandre Leboeuf, Emile Roubaud, *La maladie du sommeil au Congo français*, with a preface by Emile Roux, Paris, Société de géographie, 1909.

⁵⁹ Roubaud, *Titres et travaux*, op. cit., note 50 above. AIP, Fonds de la Société de pathologie exotique, 'Letters from Roubaud', Roubaud to Bouvier, 16 Jan. 1908, describing the reproduction of *G. palpalis* and detailing his work on the presence of trypanosomes outside the salivary glands, etc.

The mission's methods and results (the biology of *Glossina*, for example) require further analysis.⁶⁰

Roubaud's second mission (the Bouet–Roubaud expedition to French West Africa, August 1909 to November 1912) emphasized his close ties with the Institut Pasteur and the colonial and military administrations.⁶¹ Georges Bouet, the medical officer appointed head of the health services of Dakar in 1913, had worked with Roubaud in Mesnil's laboratory. The two participated in a mission to Senegal in order to study the biology and distribution of *G. palpalis*. Several questions relating to medical entomology required answers. For instance: "Which *Glossina* fly for which trypanosome?" "What are the parasite's reservoirs?" Nine species of *Glossina* flies and four trypanosomes were identified. Several letters testify that Roubaud's main interest was the study of the insect, the parasite revealing only some of its biological properties such as the physiological adaptation to climate and nutriment.⁶² Roubaud's third expedition in 1913 to Senegal was also strictly entomological and devoted to tropical agricultural entomology.⁶³ Later work by Roubaud in Paris remained predominantly entomological and situated largely outside the parasite and medical fields. It thus emerges that fundamental entomological research within the context of parasitology was indeed carried out at the Institut Pasteur and reflected in the parasitology course. However, the previously strong link between medical parasitology and entomology was loosening. Also, between the two world wars, parasitology and protistology research at the Institut Pasteur (Mesnil's laboratory included) moved gradually towards the use of these organisms in fundamental biology including re-birthing genetics.⁶⁴ The Institut Pasteur in Paris, not being a medical school, returned to fundamental biology, including that of parasites. Consequently, medical entomology was largely taught in the Instituts Pasteur d'Outre mer (IPOMs), particularly in Indochina, Madagascar and Senegal, usually in the context of newly created local medical schools.

The Institut Pasteur, the Armed Forces and Medical Entomology at the Instituts Pasteur d'Outre-mer

At the beginning of the twentieth century, courses in protozoology and tropical diseases were available to civilians mainly at the Institut de médecine coloniale of the faculty of medicine in Paris and to the military, at the Ecole du service de santé de la marine, founded by Nicolas Sadi-Carnot in Bordeaux on 10 April 1890 and attached to the University of Bordeaux's faculty of medicine and pharmacy. Another school for naval health was opened in Toulon in 1896.

⁶⁰ A Opinel, *Field medical entomology: the studies on Glossina flies by Emile Roubaud in Africa, 1906–1912*, in preparation.

⁶¹ AIP, Fonds Roubaud, Box Rub1.

⁶² AIP, Fonds de la Société de pathologie exotique, 'Roubaud's letters'. Roubaud to Mesnil, 20 April 1910: description of trypanosomes adhering to the outside of *Glossina* salivary glands. Roubaud to Mesnil, 20 March 1910: discussion of the existence of "races" of *Glossina* flies, indistinguishable morphologically but resulting from the adaptation of the insect to different temperatures and humidity.

A scientific project aimed at adapting *Glossina* flies to a precise environment thereby making the insect unable to transmit *Trypanosoma*, was also discussed. These reflexions are to be compared with the course Roubaud intended to give in 1948.

⁶³ Roubaud, *Titres et travaux*, op. cit., note 50 above.

⁶⁴ André Lwoff, *Recherches biochimiques sur la nutrition des protozoaires*, Paris, Masson, 1932. My thanks to Gabriel Gachelin for having brought this point to my attention.

The Emergence of French Medical Entomology

Due to its status as a private foundation, the Institut Pasteur had no role in medical teaching except through its unofficial medical microbiology course. Nevertheless, it was the Institut's policy to get involved in a wide range of activities, including teaching and expeditions, in order to create an influential network that accommodated both its independence as a private organization and its integration as a primary partner in French public health and the colonies through inter-institutional agreements or contracts.

In 1903, on behalf of the Institut Pasteur, Mesnil negotiated an agreement with the health services of the armed forces which stipulated that every year, ten military physicians or pharmacists would attend the Institut Pasteur's microbiology course, and that two of them would be given positions in the Institut or in the associated IPOMs. The final text of this agreement has not been found, but the point is that nearly all the directors and some members of staff of the overseas Instituts Pasteur were military physicians, a situation that persisted until recently. These physicians were under the dual control of the Institut Pasteur and the armed forces health services, and carried out research and organized local courses and training in all fields of infectious diseases including parasitology and entomology. High-level courses specializing in medical entomology were given by expatriate Pasteurians, most often at the newly created colonial universities, for example Dakar (founded in 1957) and Antananarivo, Madagascar (1955). At Hanoi University (founded in 1904) Constantin Toumanoff (1903–67) gave a course on insects as transmitters of disease. He was in charge of medical entomology throughout Indochina from 1930 to 1946.⁶⁵ Thus, medical entomology was established, taught and actively practised, and research was carried out where it was most needed, locally rather than in Paris.

In a complementary move, a decree dated 30 October 1905 created the “École d'application du service de santé des troupes coloniales”, the Pharo, which opened in 1907 and operated in close cooperation with the University of Marseilles.⁶⁶ It is noteworthy that Paul-Louis Simond, a close associate of Roux, became the first director of the school and gave the course on microbiology, which consisted of fewer than forty lessons, but was largely structured along the lines of the course offered by the Institut Pasteur. In that course, medical entomology was associated with the need to identify possibly dangerous insects in the field: the characteristics for unambiguously identifying insect vectors were well described.⁶⁷ Many of the physicians trained at the Pharo also attended the Institut Pasteur's course, and were later active in the colonies either at or in association with the IPOMs, thus completing the physical link between the Institut Pasteur and the military concerning tropical diseases and, consequently, concerning the implementation of medical entomology in the French colonies. As an *école d'application*, the Pharo did little research. But people trained there contributed a great deal to research and teaching in medical entomology overseas.

⁶⁵ AIP. Constantin Toumanoff (1903–1967), online biography, Institut Pasteur website, <http://www.pasteur.fr/infosci/archives/tou0.html>.

⁶⁶ A history of the Pharo school can be found in the anniversary book by Eric Deroo, Antoine Champeaux, Jean-Marie Milleliri, Patrick

Quéguiner, *L'école du Pharo: cent ans de médecine outre-mer, 1905–2005*, Panazol, Charles Lavauzelle, 2005.

⁶⁷ AIP, Fonds Simond, Box SIM 12, file 'P.L. Simond, Marseille 1906–1911', Simond's handwritten course.

Numerous examples of close collaboration between the Institut Pasteur and military physicians exist. They are indicated as such in published work on infectious diseases in Tonkin,⁶⁸ and field activities against sleeping sickness,⁶⁹ as if the Institut Pasteur, with little access to patients (despite its own hospital) and therefore to genuine medical activities, acquired this through its work in the colonies. Medical entomology gradually moved towards mainstream entomology in Paris under Roubaud's influence, whereas applied and epidemiological entomology moved to the colonies.

Conclusion

Medical entomology, although obviously based on earlier entomological knowledge,⁷⁰ emerged and functioned as an independent field outside the institutions in which classical entomology was dominant. The impetus for that specific development was provided by the need to meet the economic and health care requirements of the colonies, particularly concerning parasitic diseases such as malaria and sleeping sickness. Incidentally, the same phenomenon, i. e. the need to develop a research field of its own, occurred in another field of applied entomology, namely, agricultural entomology, in which Roubaud was also interested during his 1913 expedition to Senegal. Medical entomology emerged, therefore, as a response to the threat of tropical diseases, and immediately after the publication of the hypothesis of the transmission of disease by arthropods. It developed—mainly through contributions by zoologists and physicians trained in zoology—as a distinctive part of the knowledge required of physicians and researchers.

An outline of this emerging field in France shows that the first institution to establish and organize the teaching of medical entomology was the faculty of medicine in Paris (under Blanchard, Brumpt, and Neveu-Lemaire), where the subject soon became a part of the new field of parasitology. The faculty of medicine obeyed the logic of teaching and research and, through the Institut de médecine coloniale, initiated the training of civilian physicians for the colonies, and promoted international collaboration thanks largely to the outstanding figures of Blanchard and Brumpt.

Parasitology research and teaching at the Institut Pasteur was carried out in a more experimental way, dividing into two main parallel research fields under Mesnil and Roubaud.⁷¹ In the colonies parasitology was taught at the IPOMs in Africa and South-East Asia, and studied in the field. To a certain extent, it can be said that fundamental research, including medical entomology, was carried out mainly at the Institut Pasteur in Paris, using material and people largely from the colonies, whereas applied work was carried out in the colonies by some of the same people but also involved a large body of local military physicians.⁷² It must be stressed that there was a kind of circular

⁶⁸C Mathis and M Léger, *Recherches de parasitologie et de pathologie humaines et animales au Tonkin*, Paris, Masson, 1911.

⁶⁹For the Jamot expedition, see C Mathis, *L'oeuvre des pastoriens en Afrique noire: Afrique Occidentale Française*, Paris, PUF, 1946, pp. 218–29.

⁷⁰For instance *G. palpalis* had been identified as early as 1830 by Robineau-Desvoidy (Emile Brumpt, *Précis de parasitologie*, Paris, Masson, 1922, p. 861).

⁷¹It should be remembered that Roux was clearly involved in most of the decisions concerning expeditions and the study of vectors in relation to pathologies, thus defining a major research field of the Institut Pasteur.

⁷²Campaigns against sleeping sickness between 1916 and 1939 are good examples of that kind of action.

The Emergence of French Medical Entomology

movement between the Institut Pasteur, the armed forces, and the IPOMs and therefore a very tight and efficient interconnection between the Institut Pasteur and the military, a link that persisted for decades.

The actors involved thus had their own spheres of influence. They did not ignore each other, despite the lack of institutional cooperation between the faculty of medicine and the Institut Pasteur. Their common interest in tropical and arthropod-borne diseases probably explains why nearly all participated in the creation of the Société de pathologie exotique in 1907. Judging by the list of participants and the contributors to its journal, the Société provided an ideal space in which French medical entomology and parasitology could meet.